Buckhorn Brook

Watershed Summary

Watershed Description and Maps

The Buckhorn Brook watershed covers an area of approximately 3,164 acres in the north central area of Connecticut (Figure 1). There are several towns located at least partially in the watershed, including the municipalities of East Windsor, Ellington, Somers, and Enfield, CT.

The Buckhorn Brook watershed includes one segment addressed in this TMDL impaired for recreation due to elevated bacteria levels (CT4205-00_01). This segment was assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. An excerpt of the Integrated Water Quality Report is included in Table 1 (CTDEEP, 2010).

Buckhorn Brook (CT4205-00_01) begins at the outlet of Tobacco Pond No. 2 just north of Town Farm Road in Enfield, flows south through the Grassmere Golf Course, crosses Abbee Road in Enfield, and ends at the confluence with the Scantic River southwest of Kimberly Drive in Enfield. The segment is 2.02 miles long and is located entirely within the Town of Enfield (Figure 2).

The impaired segment of Buckhorn Brook has a water quality classification of A. Designated uses include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. This segment of the river is impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches in this segment of Buckhorn Brook, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Impaired Segment Facts

Impaired Segment:
Buckhorn Brook (CT4205-00_01)

Municipalities: Enfield

Impaired Segment Length (miles):
2.02

Water Quality Classification:
Class A

Designated Use Impairment:
Recreation

Sub-regional Basin Name and Code: Buckhorn Brook, 4205

Regional Basin:
Connecticut Main Stem

Major Basin: Connecticut

Watershed Area (acres): 3,164

MS4 Applicable: Yes

Applicable Season: Recreation Season (May 1 to September 30)

Figure 1: Watershed location in Connecticut

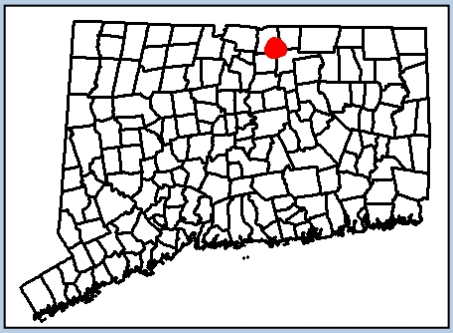


Table 1: Impaired segment and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

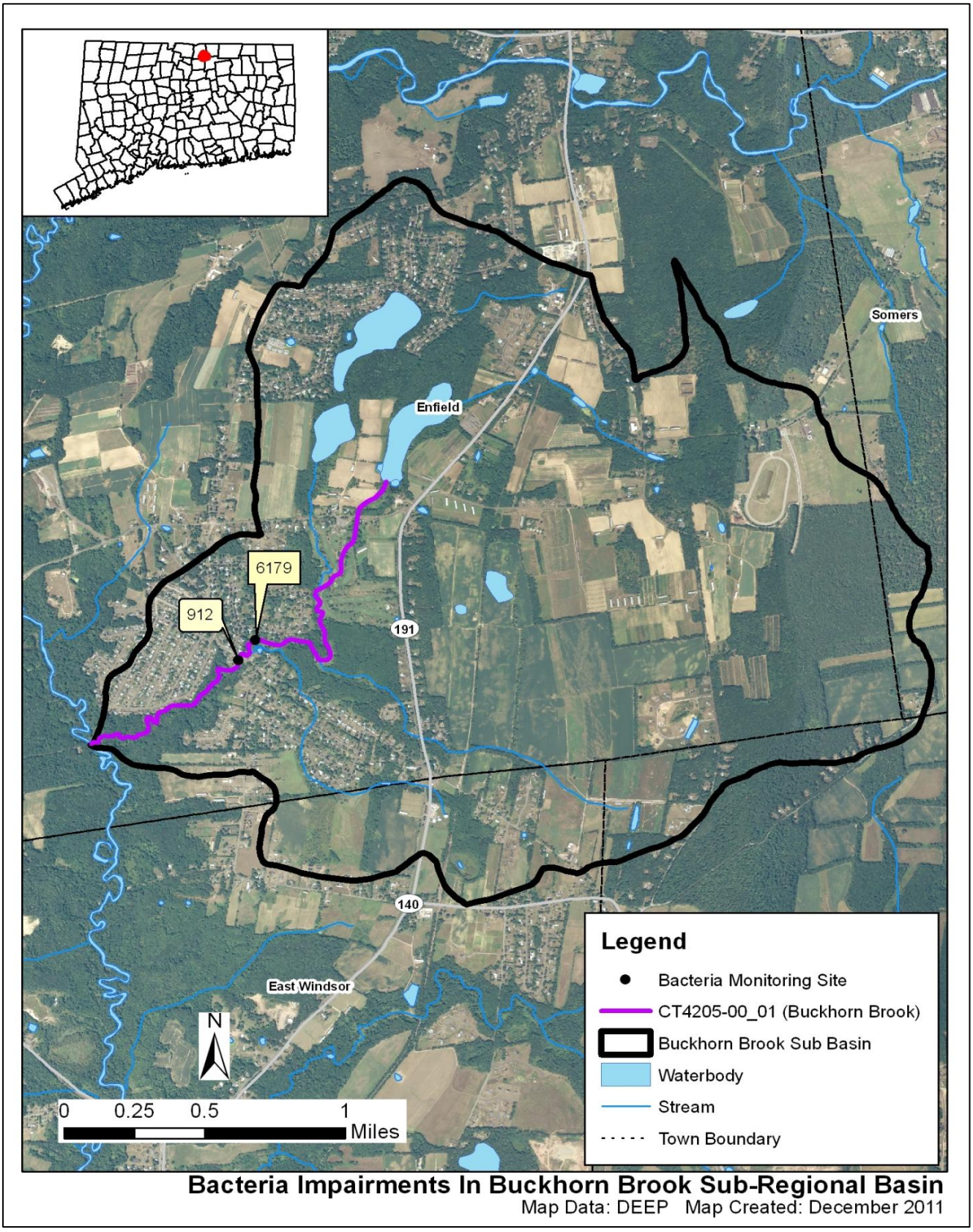
Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT4205-00_01	Buckhorn Brook (Enfield)-01	From mouth at confluence with Scantic River, US to marsh (US of Town Farm Road crossing) near inlet from Tobacco Pond No 2, Enfield.	2.02	U	NOT	FULL*

FULL = Designated Use Fully Supported

NOT = Designated Use Not Supported

U = Unassessed

Figure 2: GIS map featuring general information of the Buckhorn Brook watershed at the sub-regional level



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Buckhorn Brook watershed consists of 26% urban area, 26% forest, 46% agriculture, and 2% water. The majority of the land near the impaired segment is a mix of urban, agricultural, and forested land uses. There are several high-density residential developments near the impaired segment off Kimberly Drive and Sandpiper Road in Enfield. There are multiple large agricultural operations throughout the watershed, particularly near the impaired segment and its tributaries.

Figure 3: Land use within the Buckhorn Brook watershed

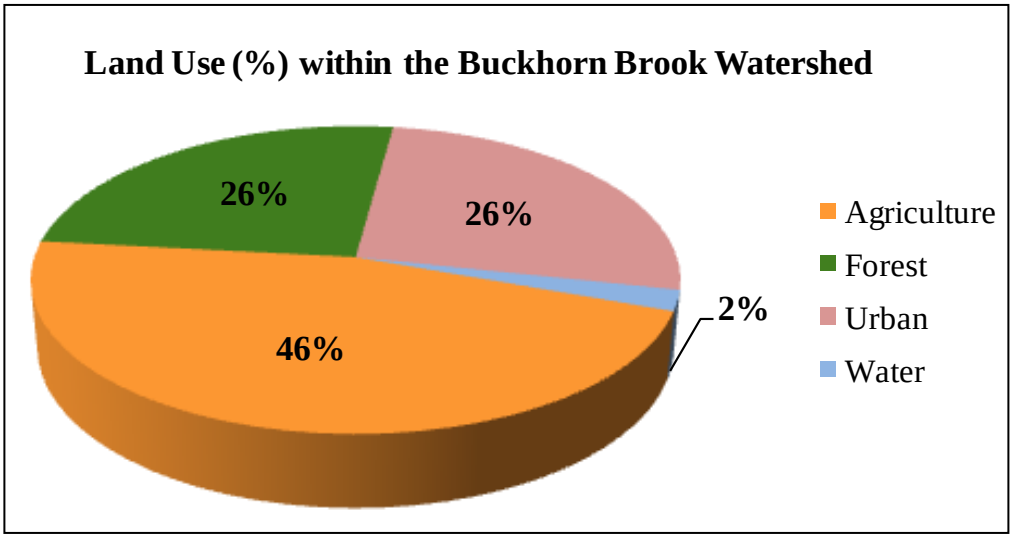
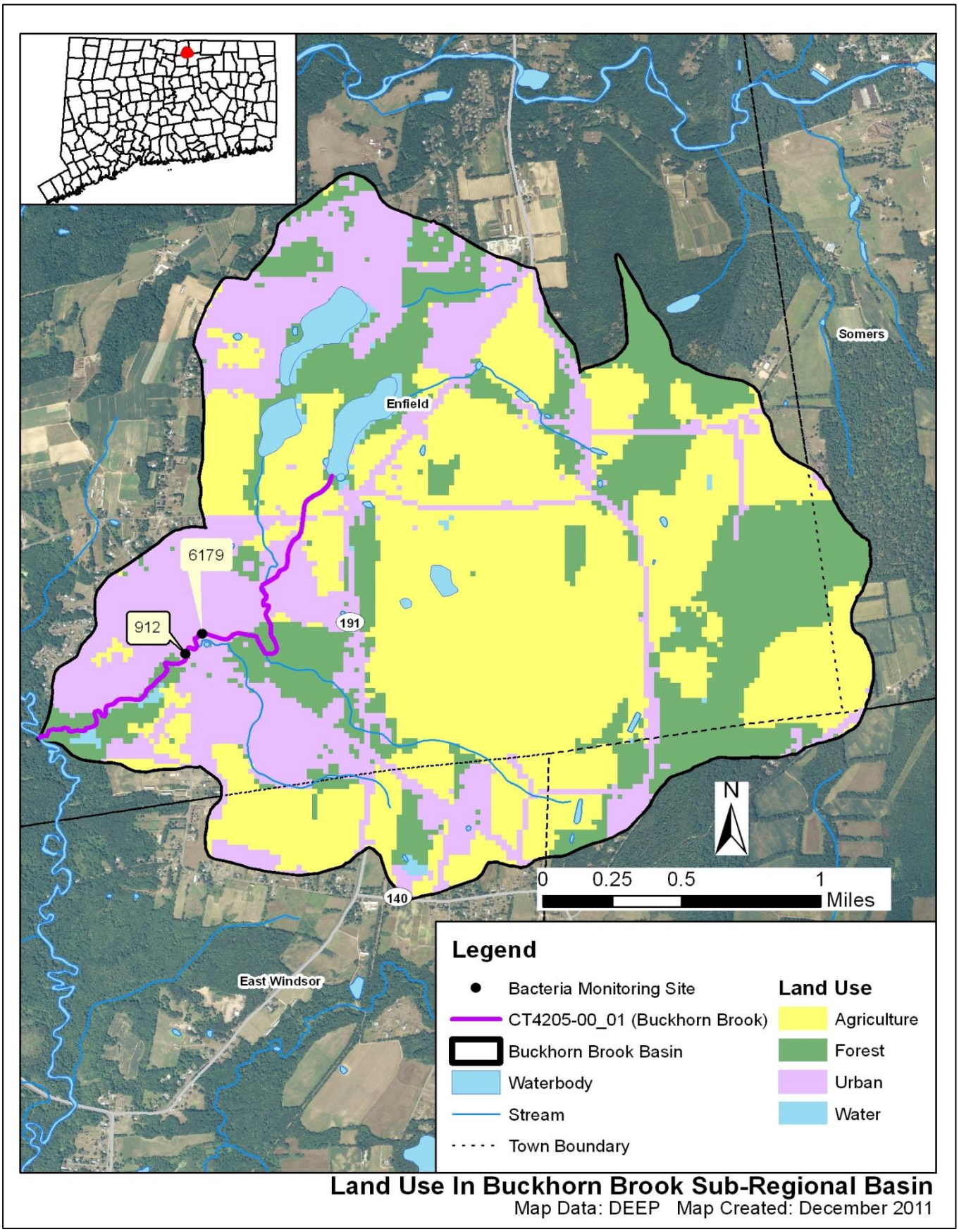


Figure 4: GIS map featuring land use for the Buckhorn Brook watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segment.

Table 2: Sampling station location description for the impaired segment in the Buckhorn Brook watershed (stations organized downstream to upstream)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT4205-00_01	Buckhorn Brook	912	Abbe Road	Enfield	41.950808	-72.538969
CT4205-00_02	Buckhorn Brook	6179	Abbe Road	Enfield	41.951900	-72.537800

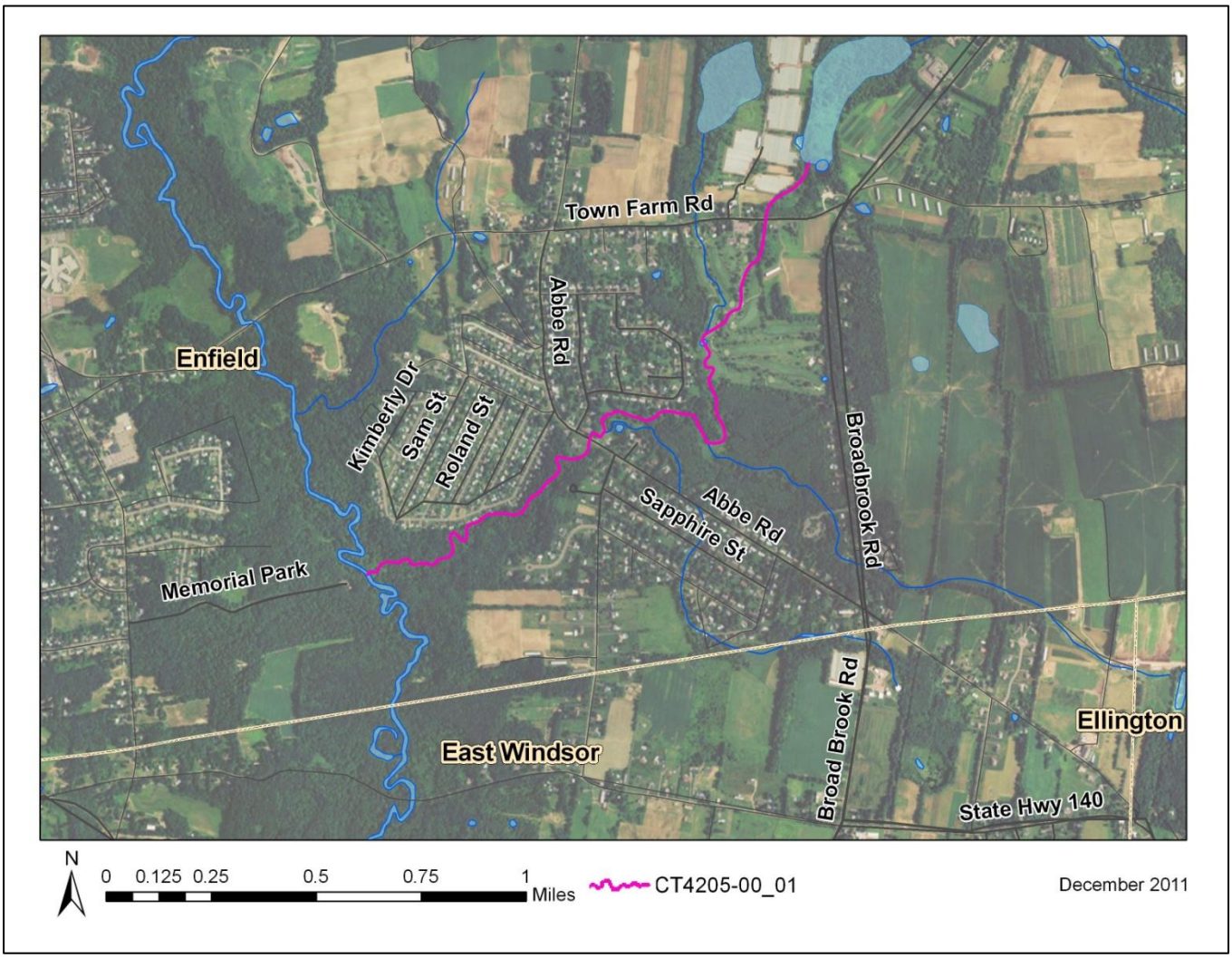
Buckhorn Brook's impaired segment (CT4205-00_01) is a Class A freshwater river (Figure 5). Its applicable designated uses are potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from two sampling locations, Stations 912 and 6179, from 2003 and 2006-2010 (Table 2).

The water quality criteria for *E. coli*, along with bacteria sampling results in 2003 and from 2006-2010, are presented in Table 9. The annual geometric mean was calculated for Station 912 and exceeded the WQS for *E. coli* in every year from 2006-2010. Single sample values at this station exceeded the WQS for *E. coli* multiple times in all sampling years. The annual geometric mean was calculated for Station 6179 in 2010 and exceeded the WQS for *E. coli.* Single sample values exceeded the WQS for *E. coli* once in 2010 at Station 6179.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for Stations 912 and 6179 for wet-weather and dry-weather sampling days, where possible (Table 9). For Station 912, the geometric mean exceeded the WQS for *E. coli* during both wet and dry-weather with wet-weather values twice that of dry-weather. As there were no wet-weather sample dates for Station 6179, only the geometric mean during dry-weather exceeded the WQS for *E. coli*.

Due to the elevated bacteria measurements presented in Table 9, this segment of the Buckhorn Brook did not meet CT's bacteria WQS, was identified as impaired, and was placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of the impaired segment of Buckhorn Brook



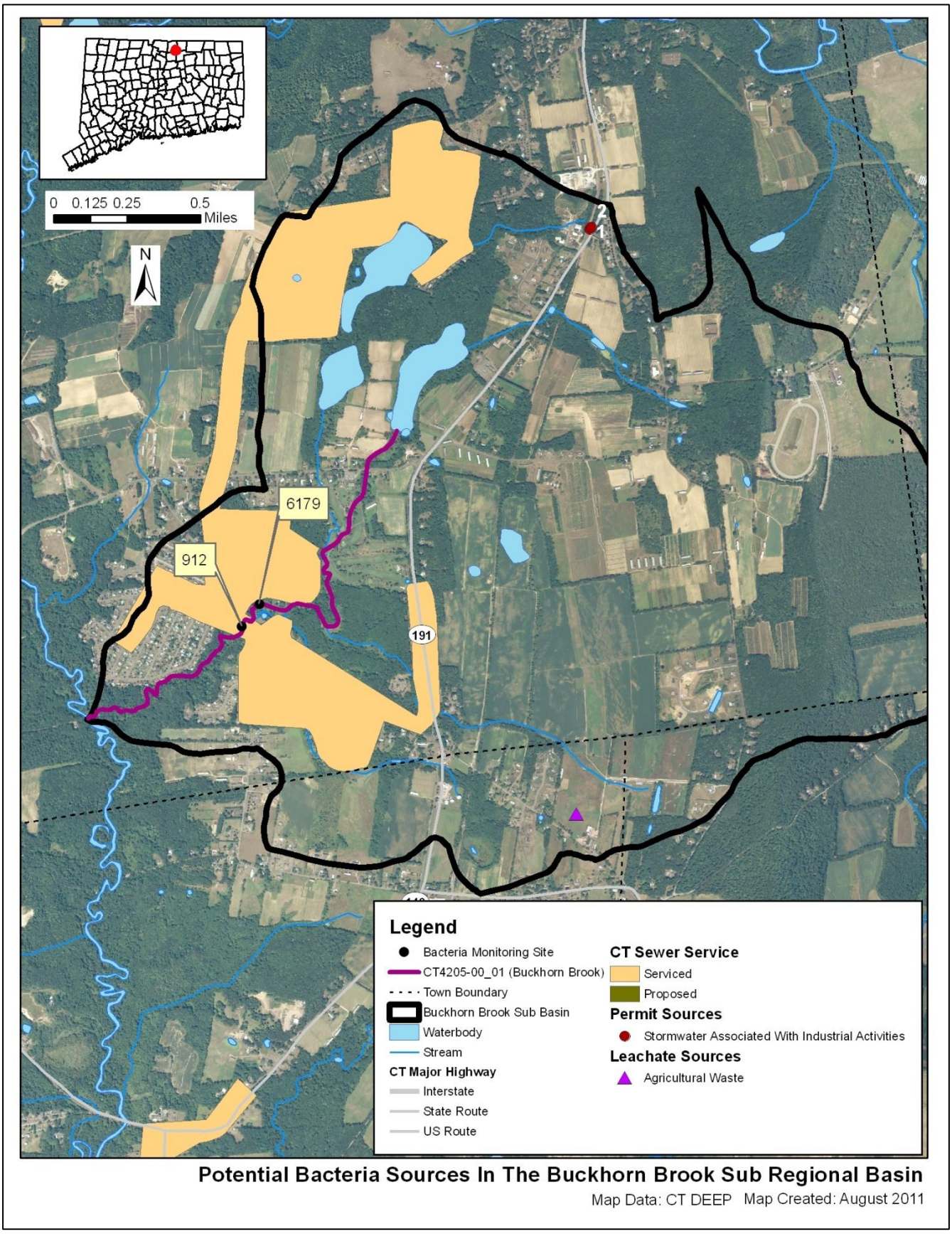
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segment. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed may be listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the Buckhorn Brook watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/Pets	Other
Buckhorn Brook CT4205-00_01	**x**	**x**		**x**	**x**	**x**	**x**	

Figure 6: Potential sources in the Buckhorn Brook watershed at the sub-regional level



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring may reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	0
GSI	Stormwater Associated with Industrial Activity	2
GSM	Part B Municipal Stormwater MS4	1
GSN	Stormwater Registration – Construction	0
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

Permitted Sources

As shown in Table 5, there are several permitted discharges in the Buckhorn Brook watershed. Bacteria data from 2002-2003 from one of these industrial permitted facilities are included in Table 6. Though this data cannot be compared to the CT WQS as there is no recreation standard for fecal coliform bacteria, one sample was high from the Boticello Maintenance Garage & Sand & Gravel Operation Permit (GSI000381), exceeding 2,000 colonies/100 mL.

Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Buckhorn Brook watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Enfield	Botticello, Incorporated	GSI000381	Stormwater Associated With Industrial Activities	Maintenance Garage & Excavation Operation	1
Enfield	Town of Enfield	GSM000086	Part B Municipal Stormwater MS4	Enfield, Town of	NA
Enfield	A. K. O., Inc.	GSI001760	Stormwater Associated With Industrial Activities	A.K.O., Inc.	2

Table 6: Industrial permits in the Buckhorn Brook watershed and available fecal coliform data (colonies/100 mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform.

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
Enfield	Boticello Maintenance Garage & Sand & Gravel Operation	GSI000381	Buckhorn Brook #4205	DSN-001	03/26/02	2
Enfield	Boticello Maintenance Garage & Sand & Gravel Operation	GSI000381	Buckhorn Brook #4205	DSN-001	07/22/03	>2000

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

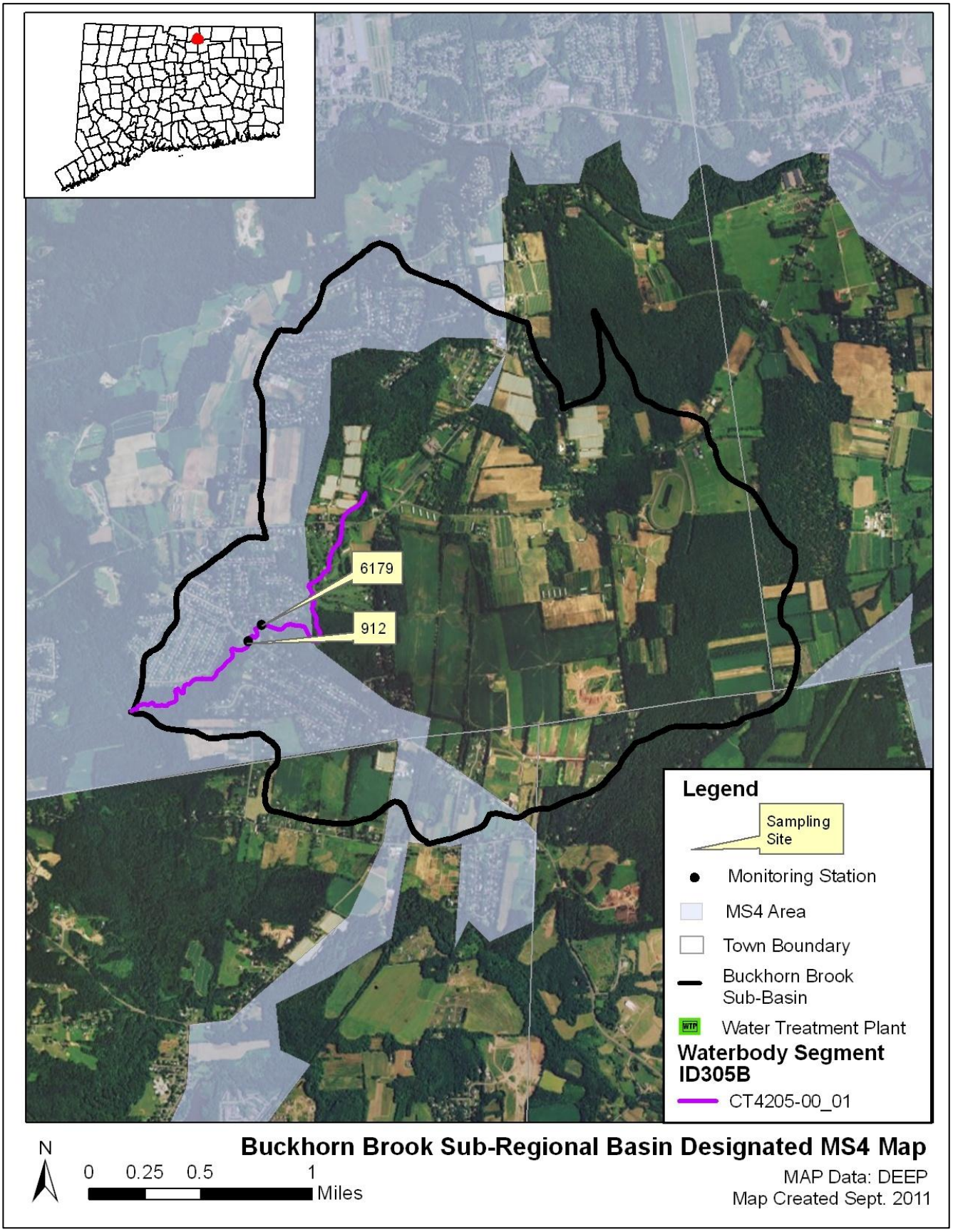
While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

The impaired segment of Buckhorn Brook is located within the Town of Enfield. Enfield has designated urban areas within the Buckhorn Brook watershed, as defined by the U.S. Census Bureau. Therefore, Enfield is required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the CT DEEP (Figure 7). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit required municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Figure 7: MS4 areas of the Buckhorn Brook watershed



Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Buckhorn Brook watershed are described below.

Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of vegetated buffer along the shoreline. At 46%, agricultural land has the highest land use within the watershed. There are many areas where agricultural lands are close to the impaired segment of Buckhorn Brook and its tributaries, particularly off Grant Road, Broad Brook Road, and Laughlin Road in Enfield. As seen in Figure 6, agricultural leachate is a potential bacteria source near Kreyssig Road in East Windsor. Agricultural areas near the impaired segment and its tributaries are potentially carrying pollutants, including bacteria, into Buckhorn Brook.

Stormwater Runoff from Developed Areas

Approximately 26% of the watershed is considered urban, and much of that area is concentrated around the impaired segment in the southern portion of Enfield near the downstream terminus of the impaired segment (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000). The majority (64%) of the Buckhorn Brook watershed is characterized by 0-6% impervious cover, 28% is characterized by 7-11% impervious cover, and 8% is characterized by 12-15% impervious cover (Figure 8). The amount of impervious surfaces near the impaired segment increases as the brook flows downstream through Enfield. The amount and proximity of impervious surfaces to Buckhorn Brook indicate that stormwater runoff from developed areas is a potential source of bacterial contamination.

Figure 8: Range of impervious cover (%) in the Buckhorn Brook watershed

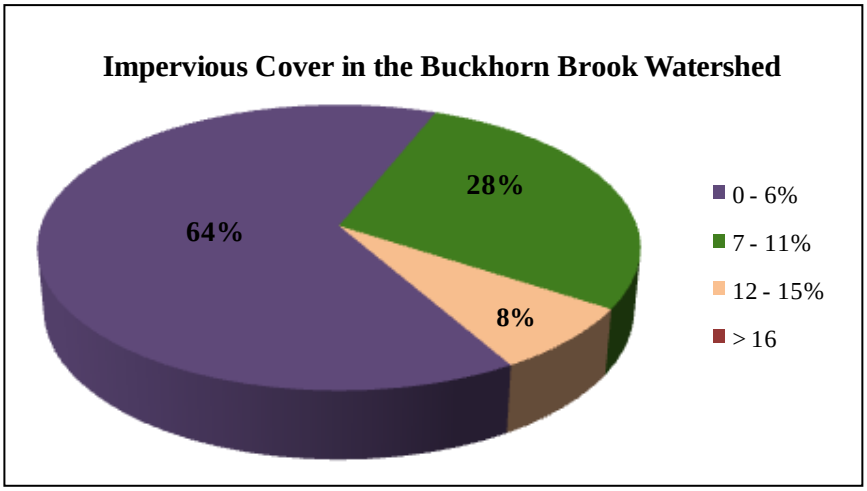
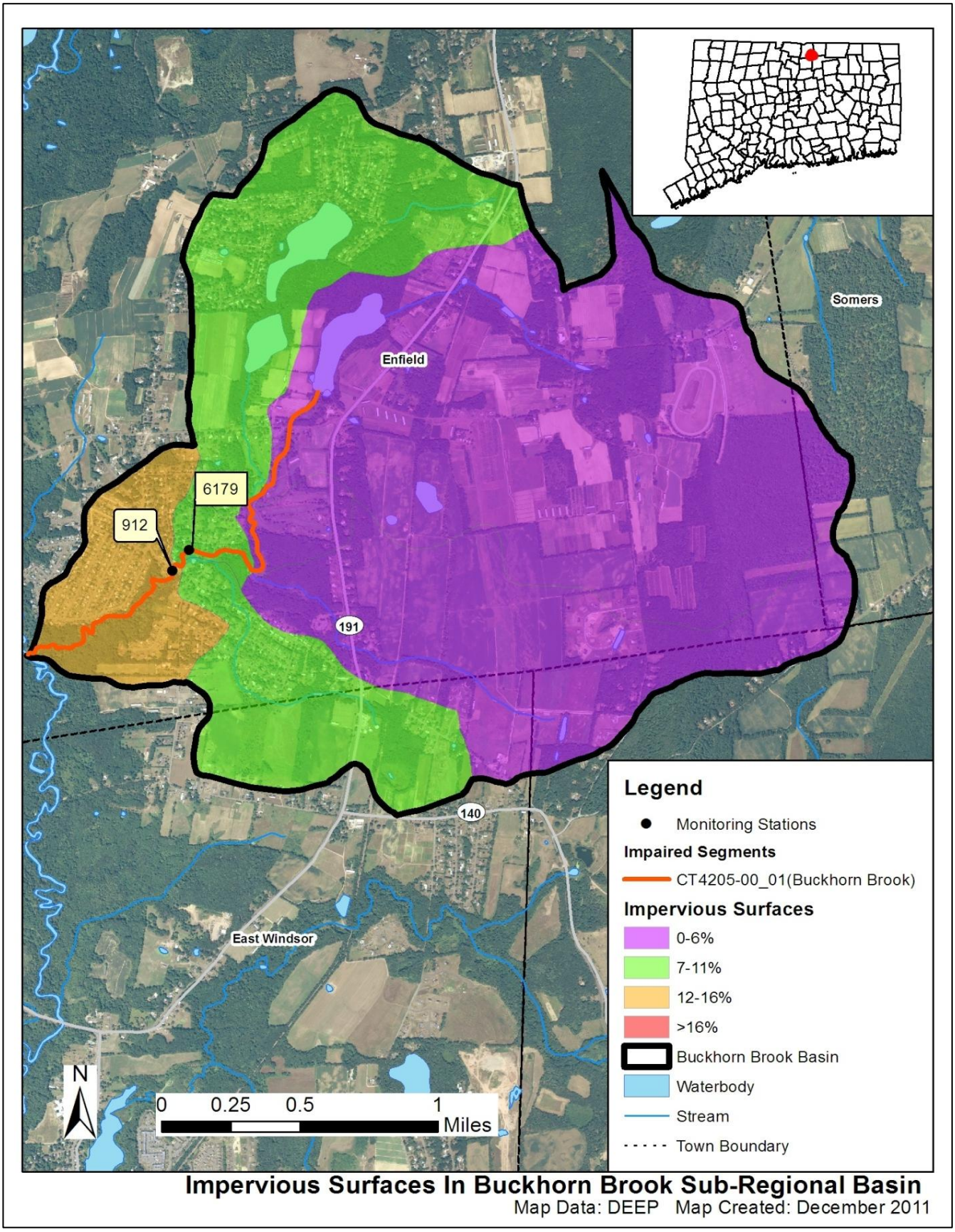


Figure 9: Impervious cover (%) for the Buckhorn Brook sub-regional watershed



Insufficient Septic Systems and Illicit Discharges

As shown in Figure 6, portions of the watershed are serviced by sanitary sewers. Households and businesses in the non-serviced areas of the watershed must rely on onsite wastewater treatment systems, such as septic systems. Given the number of septic systems in the area, there may be failed septic systems in the watershed that are currently undetected. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Town of Enfield is part of the regional North Central District Health District (www.ncdhd.org/) which handles insufficient or failing septic systems in the town.

There are several areas of the watershed around the impaired segment that have access to a sanitary sewer system (Figure 6). Sewer system leaks and other illicit discharges can contribute bacteria to nearby surface waters.

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Buckhorn Brook watershed represent another potential source of bacteria. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001).

Geese and other waterfowl are known to congregate in open areas including recreational fields, golf courses, agricultural crop fields, and ponds. The upstream potion of the impaired segment flows through the Grassmere Golf Course off Town Farm Road in Enfield. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas in golf courses and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants. These factors make wildlife waste a potential source of bacteria to Buckhorn Brook.

Also, urban development surrounds large portions of the downstream reaches of the impaired segment of Buckhorn Brook (Figure 5). When not properly disposed, waste from domestic animals, such as dogs, can enter surface waters directly or through stormwater infrastructure. Therefore, domestic animal waste may also be contributing to bacteria concentrations in Buckhorn Brook.

Additional Sources

The Boticello Maintenance Garage & Sand & Gravel Operation sampling has been shown to contain high levels of fecal coliform bacteria, an indicator of bacterial pollution (Table 6).

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in Buckhorn Brook. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

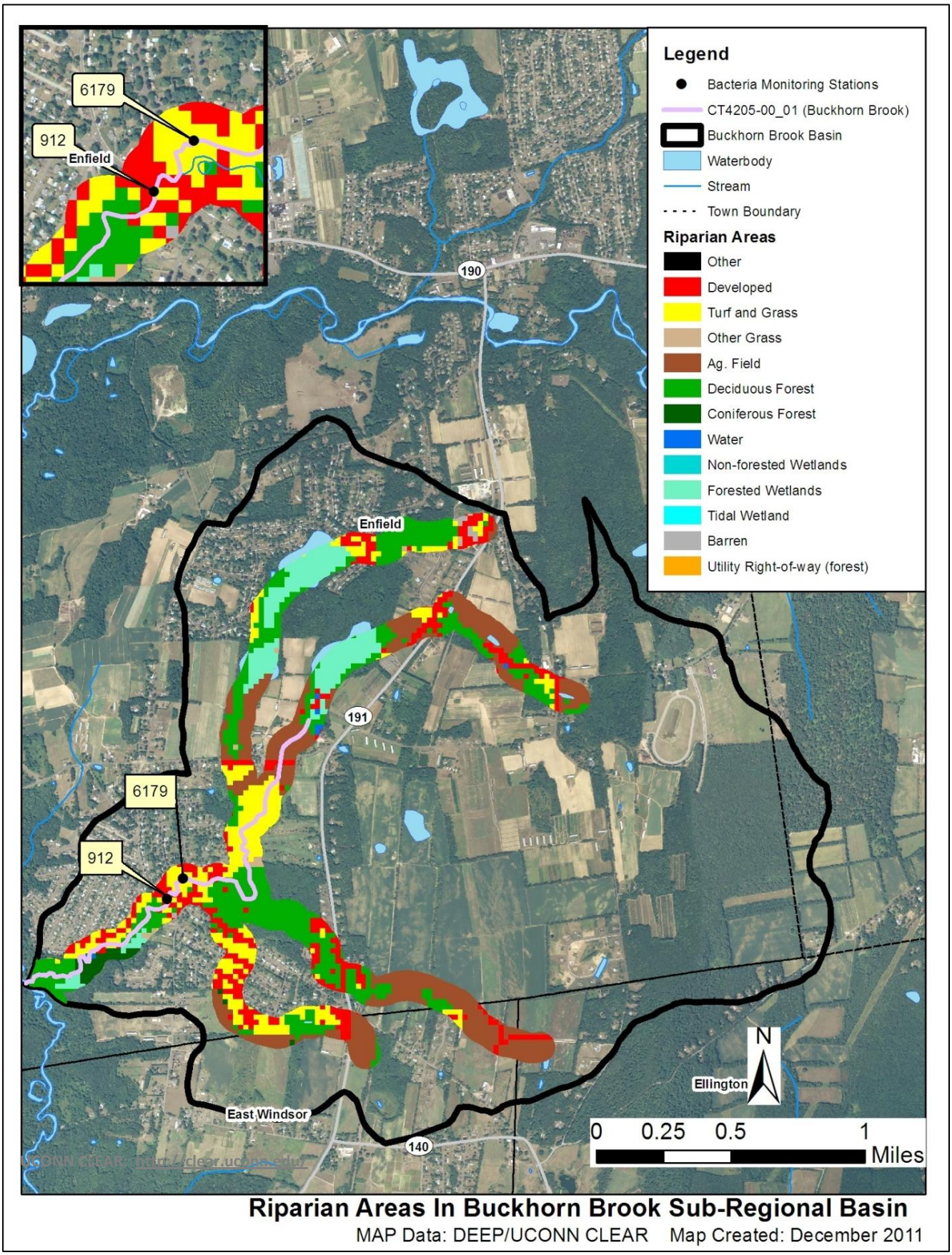
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (http://clear.uconn.edu/), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for the impaired segment of Buckhorn Brook is characterized by agricultural, developed, and turf/grass land uses (Figure 10). The riparian zones for the tributaries to Buckhorn Brook, especially those entering the brook in its downstream reaches, are dominated by agricultural land uses. As previously mentioned, agricultural, developed, and turf/grass areas (such as golf courses) are potential sources of bacterial contamination.

Figure 10: Riparian buffer zone information for the Buckhorn Brook watershed



CURRENT MANAGEMENT ACTIVITIES

The Town of Enfield has developed and implemented programs to protect water quality from bacterial contamination. As indicated previously, a portion of the watershed surrounding the impaired segment is regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the State. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Municipalities are also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Table 7.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Enfield, CT (Permit # GSM000086)

Minimum Measure	Enfield 2005 Annual Updates
Public Outreach and Education	1) Supporting annual cleanup of CT River and Scantic River. 2) Created Source to Sea Clean Up program to perform rubbish and other debris only the CT River
Public Involvement and Participation	1) Supplied education material relating to treatment and preservation of inland wetlands and watercourses. 2) Supplied information to property owners regarding the protection and preservation of steep slopes to erosion.
	3) Initiating a program for catch basin marking and watercourse signage
Illicit Discharge Detection and Elimination	1) Initiated non-point source storm water monitoring at six locations. 2) Developed town wide watershed map and storm drainage outlet locations. 3) Initiated monthly collection of motor oil & automotive batteries
Construction Site Stormwater Runoff Control	1) Established regular random inspections of construction sites to ensure compliance.
Post Construction Stormwater Management	No Updates
Pollution Prevention and Good Housekeeping	1) Created inventory of stormwater facilities and outfalls.

RECOMMENDED NEXT STEPS

Future mitigative activities are necessary to ensure the long-term protection of the impaired segment of Buckhorn Brook and have been prioritized below.

1) Ensure there are sufficient buffers on agricultural lands along Buckhorn Brook.

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to those agricultural operations located along the impaired segment and along tributary streams of the impaired segment.

2) Identify areas along the impaired segment of Buckhorn Brook to implement Best Management Practices (BMPs) to control stormwater runoff.

Since 26% of the watershed is considered urban, particularly near the impaired segment, stormwater runoff is likely contributing bacteria to the waterbody. To identify specific areas that are contributing bacteria to the impaired segment, the town has already conducted NPS sampling at six stormwater monitoring sites. The town should continue to conduct wet-weather sampling at stormwater outfalls that discharge directly to Buckhorn Brook. To treat stormwater runoff, the town should also identify areas along the more developed sections of Buckhorn Brook, particularly along the impaired segment, to install BMPs that encourage stormwater to infiltrate into the ground before entering Buckhorn Brook. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document.

3) Develop a system to monitor septic systems.

Many of the residents in the watershed rely on septic systems (Figure 6). If not already in place, Enfield should establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems.

4) Implement a program to evaluate the sanitary sewer system.

Portions of the Buckhorn Brook watershed rely on the sanitary sewer system, particularly adjacent to the impaired segment (Figure 6). Ensuring there are no leaks or overflows from the sanitary sewer in this area should be made a priority. The town has already mapped storm drainage outlet locations. It is important for Enfield to continue to develop a program that evaluates its sanitary sewer and reduces leaks and overflows, especially in the areas near Buckhorn Brook. This program should include periodic inspections of the sewer line.

5) Evaluate municipal education and outreach programs regarding animal waste.

Enfield can take measures to minimize waterfowl-related impacts such as encouraging residents and businesses to allow tall, coarse vegetation to grow in the riparian areas of the impaired segment of Buckhorn Brook that are frequented by waterfowl, particularly within golf courses, recreational fields,

and agricultural cropfields. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shoreline will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments in the Buckhorn Brook watershed and can harm human health and the environment.

Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

6) Continue monitoring of permitted sources.

Previous sampling of a discharge from the Boticello Maintenance Garage & Sand & Gravel Operation revealed elevated levels of fecal coliform bacteria, an indicator of bacterial pollution (Table 6). Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 8 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Buckhorn Brook watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall

stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 8. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

		Instantaneous *E. coli* (#/100mL)						Geometric Mean *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[6]**			**LA[6]**			**WLA[6]**	**LA[6]**
	Recreational Use	**1**	**2**	**3**	**1**	**2**	**3**	**All**	**All**
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	
	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	576		126

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

(2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(3) **All Other Recreational Uses.**

(4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)

(5) Human direct discharge = swimmers

(6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(7) Replace numeric value with “natural levels” if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 9: Buckhorn Brook Bacteria Data

Waterbody ID: CT4205-00_01

Characteristics: Freshwater, Class A, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **95%**

Single Sample: **98%**

Data: 2003 and 2006-2010 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on the Buckhorn Brook with annual geometric means calculated

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
912	At # 277 Abbe Road	4/24/2003	470	dry	NA
912	At # 277 Abbe Road	6/14/2006	1500	wet	**2502* (95 %)**
912	At # 277 Abbe Road	6/28/2006	24000	wet	
912	At # 277 Abbe Road	7/3/2006	680	dry	
912	At # 277 Abbe Road	7/25/2006	960	dry	
912	At # 277 Abbe Road	8/3/2006	8700	dry	
912	At # 277 Abbe Road	8/10/2006	880	dry	
912	At # 277 Abbe Road	8/16/2006	**24001†* (98%)**	wet	
912	At # 277 Abbe Road	8/22/2006	6300†	dry	
912	At # 277 Abbe Road	8/31/2006	1800	dry	
912	At # 277 Abbe Road	9/6/2006	1200†	dry	
912	At # 277 Abbe Road	9/12/2006	410	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on the Buckhorn Brook with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
912	At # 277 Abbe Road	6/6/2007	2300†	wet	899
912	At # 277 Abbe Road	6/13/2007	3100	dry	
912	At # 277 Abbe Road	6/21/2007	492†	dry	
912	At # 277 Abbe Road	6/27/2007	41	dry	
912	At # 277 Abbe Road	7/11/2007	970†	wet	
912	At # 277 Abbe Road	7/23/2007	1300†	wet	
912	At # 277 Abbe Road	8/2/2007	1300	dry	
912	At # 277 Abbe Road	8/16/2007	960	dry	
912	At # 277 Abbe Road	8/23/2007	2500	dry	
912	At # 277 Abbe Road	8/28/2007	610	dry	
912	At # 277 Abbe Road	5/22/2008	85	dry	1587
912	At # 277 Abbe Road	6/4/2008	5000	wet	
912	At # 277 Abbe Road	6/11/2008	1200	dry	
912	At # 277 Abbe Road	6/16/2008	430	wet	
912	At # 277 Abbe Road	6/23/2008	17000†	wet	
912	At # 277 Abbe Road	7/7/2008	2600	dry	
912	At # 277 Abbe Road	7/31/2008	1400	wet	
912	At # 277 Abbe Road	8/6/2008	20000	wet	
912	At # 277 Abbe Road	8/14/2008	585†	dry	
912	At # 277 Abbe Road	8/20/2008	640†	dry	
912	At # 277 Abbe Road	6/3/2009	2100	dry	1821
912	At # 277 Abbe Road	6/10/2009	510	wet	
912	At # 277 Abbe Road	6/25/2009	1700	dry	
912	At # 277 Abbe Road	7/15/2009	400	dry	
912	At # 277 Abbe Road	7/22/2009	24000†	wet	
912	At # 277 Abbe Road	7/29/2009	670	wet	
912	At # 277 Abbe Road	8/13/2009	10000	dry	
912	At # 277 Abbe Road	8/20/2009	4100	dry	
912	At # 277 Abbe Road	9/2/2009	460	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Buckhorn Brook with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
912	At # 277 Abbe Road	6/3/2010	2800	wet	2255
912	At # 277 Abbe Road	6/10/2010	910	wet	
912	At # 277 Abbe Road	6/15/2010	640	dry	
912	At # 277 Abbe Road	6/17/2010	2200	dry	
912	At # 277 Abbe Road	6/24/2010	1100	wet	
912	At # 277 Abbe Road	6/29/2010	2000	dry	
912	At # 277 Abbe Road	7/8/2010	7700	dry	
912	At # 277 Abbe Road	7/15/2010	1500†	wet	
912	At # 277 Abbe Road	7/22/2010	700	dry	
912	At # 277 Abbe Road	7/29/2010	12000	dry	
912	At # 277 Abbe Road	8/3/2010	1700	dry	
912	At # 277 Abbe Road	8/5/2010	4400	wet	
912	At # 277 Abbe Road	8/12/2010	910	dry	
912	At # 277 Abbe Road	8/19/2010	4200	dry	
912	At # 277 Abbe Road	8/26/2010	1600	dry	
912	At # 277 Abbe Road	9/2/2010	1600	dry	
912	At # 277 Abbe Road	9/9/2010	2200	dry	
912	At # 277 Abbe Road	9/15/2010	1000	dry	
912	At # 277 Abbe Road	9/20/2010	3700	dry	
912	At # 277 Abbe Road	9/23/2010	5200	dry	
912	At # 277 Abbe Road	9/30/2010	11000	wet	
6179	500 feet upstream of Abbe Road crossing	8/12/2010	1400	dry	343
6179	500 feet upstream of Abbe Road crossing	8/19/2010	84	dry	

Shaded cells indicate an exceedance of water quality criteria

†**Average of two duplicate samples**

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather geometric mean values for all monitoring stations on Buckhorn Brook

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
912	At # 277 Abbe Road	2003-2010	20	42	1769	3031	1369
6179	500 feet upstream of Abbe Road crossing	2010	0	2	343	NA	343

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gage at the Hartford Bradley International Airport

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